Supplementary information

Janus Nanoparticles for Contrast Enhancement of T_1-T_2 Dual Mode Magnetic Resonance Imaging

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1. X-ray diffraction analysis

XRD pattern of the precursor $MnFe_2O_4$ nanoparticles (Figure S1) confirms its face centered cubic phase (JCPDS file no. 74-2403).[1] XRD pattern of the synthesized $MnFe_2O_4$@MnO Janus nanosystem (Figure S1) showed peaks representing both MnO (JCPDS 75-1090) [2] and $MnFe_2O_4$ crystal lattice planes. From the XRD spectra, the crystallinity was observed to be compromised to some extent. This can be attributed to the fact that all the synthesis procedures involved relatively low temperature and no calcination step was performed [3].

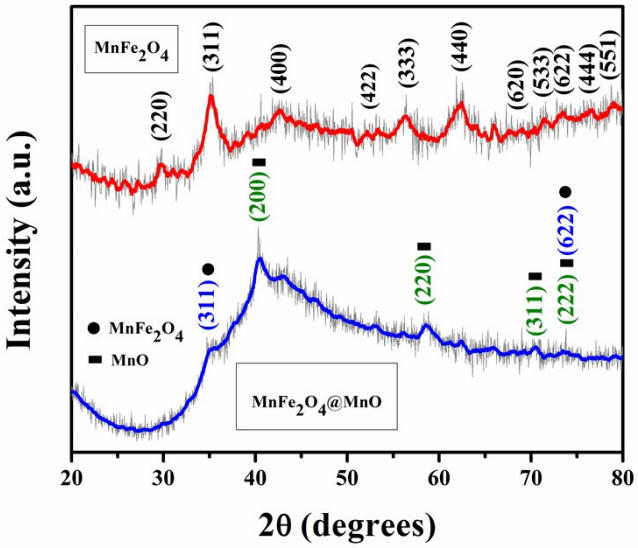

Figure S1 XRD pattern of $MnFe_2O_4$ nanoparticles and $MnFe_2O_4$@MnO Janus nanosystem

2. SEM analysis and elemental mapping

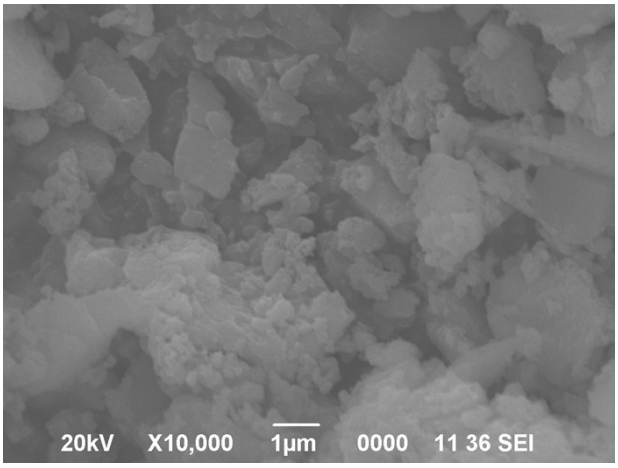

Figure S2 SEM of $MnFe_2O_4$@MnO Janus nanosystem

The elemental mapping analysis shown in Figure S3 reveals the presence of Mn, Fe and O in $MnFe_2O_4$@MnO Janus nanosystem. It is observed that all the three elements are consistently distributed throughout the material.

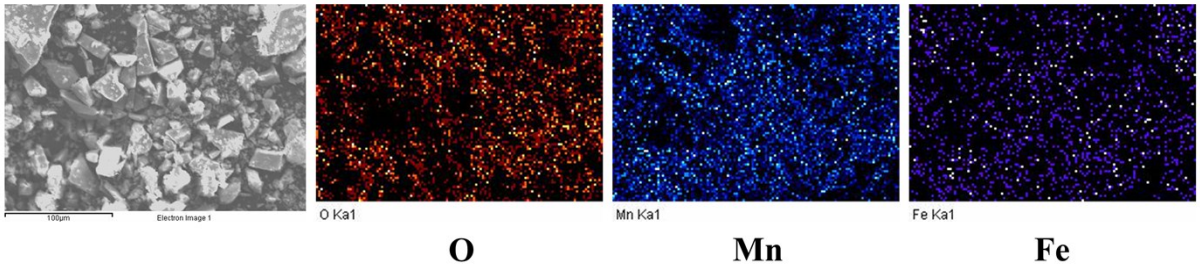

Figure S3 Elemental mapping of $MnFe_2O_4$@MnO Janus nanosystem

3. TEM analysis of $MnFe_2O_4$ nanoparticles

TEM image of the synthesized $MnFe_2O_4$ nanoparticles shown in Figure S4(a) exhibited spherical morphologies in the size range of 120-300 nm. A closer view (Figure S4(b)) reveals that these microspheres are actually assemblies of nanoparticles. Figure S4(c) further confirms the crystallinity of the particles and planes present in them were identified from SAED pattern (Figure S4(d)).

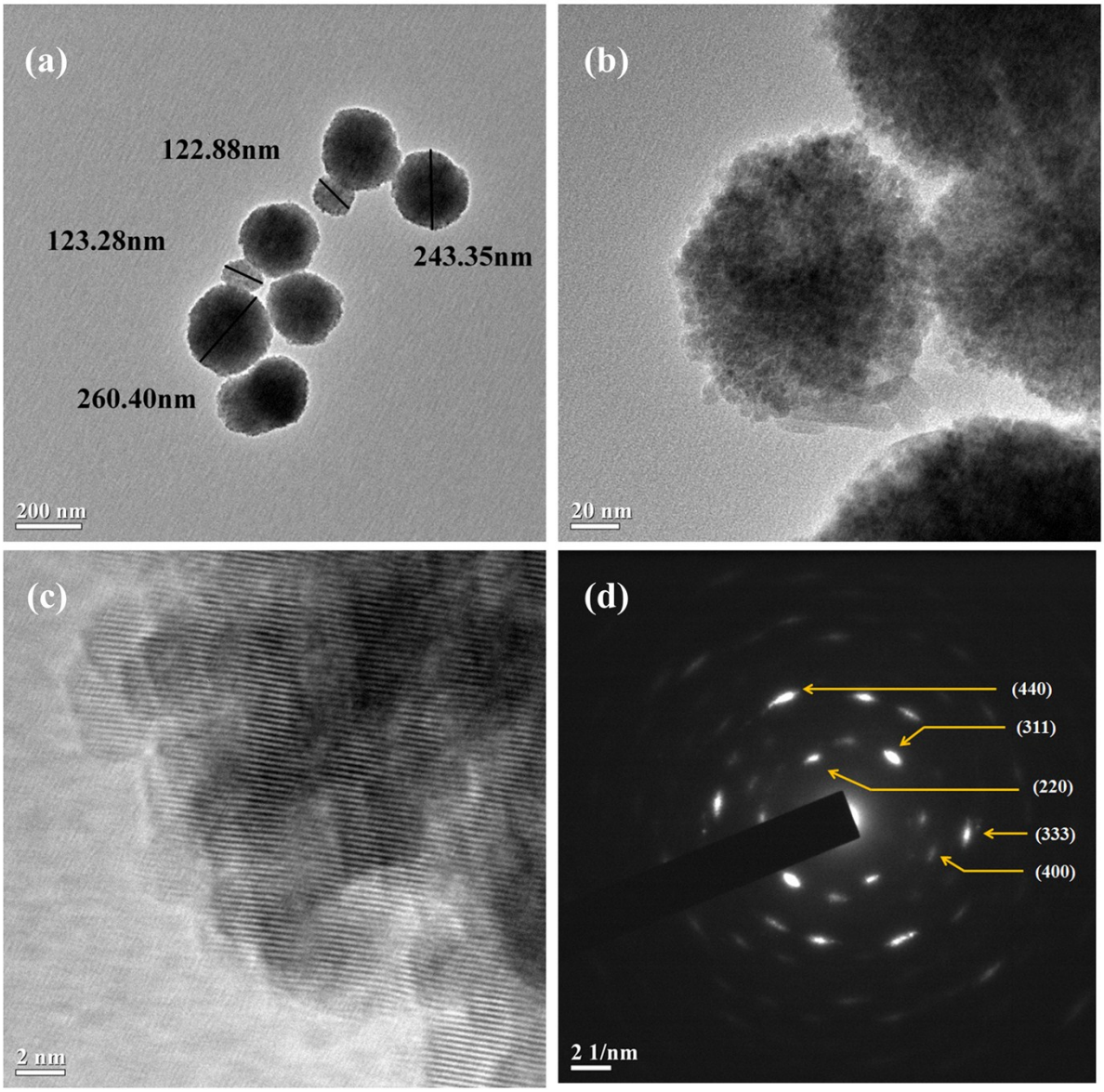

Figure S4 (a) – (c) TEM images **(d)** SAED pattern of $MnFe_2O_4$ nanoparticles

4. Amount of PEG coating

The amount of PEG coated on the nanoparticles were determined through thermogravimetric analysis and it was found to be 21%.

5. Interaction of the PEG stabilized Janus nanoparticles with cell lines

5.1 Interaction with HEK 293 cell line

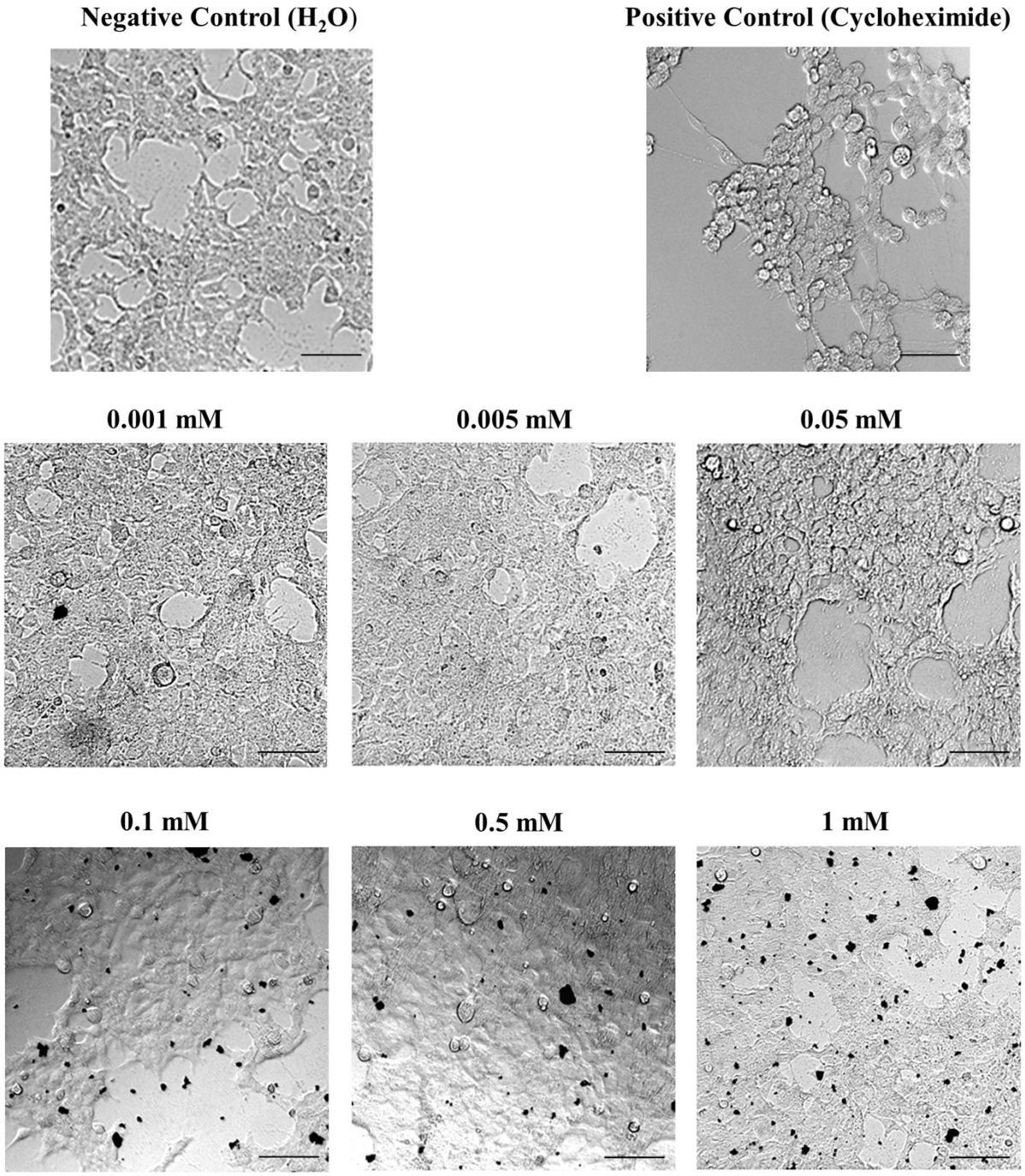

Fig. S5 Interaction of PEG stabilized Janus nanoparticles with HEK 293 cell line (Scale bar = 50 μm)

5.2 Interaction with HEPA 1-6 cell line

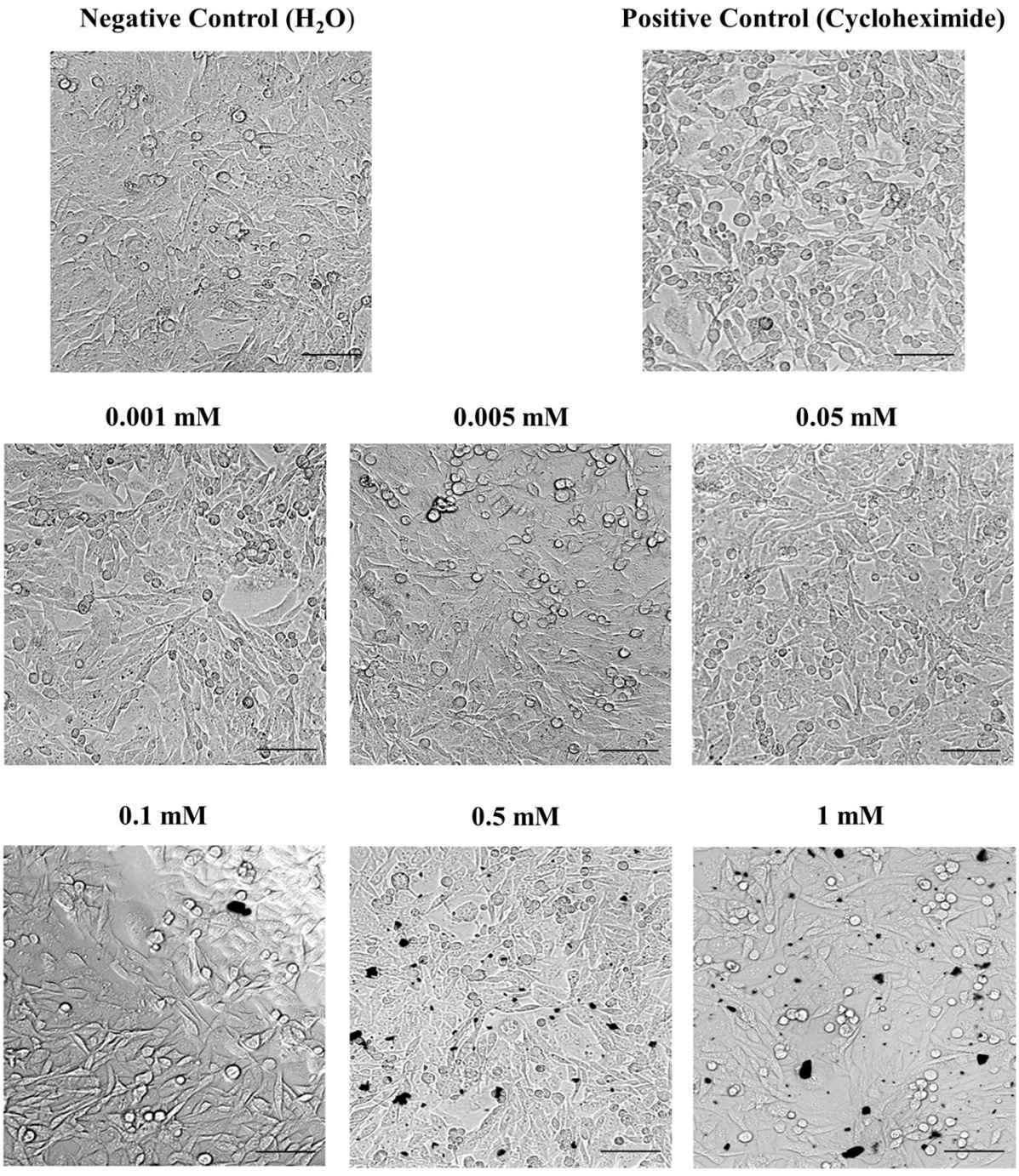

Fig. S6 Interaction of PEG stabilized Janus nanoparticles with HEPA 1-6 cell line (Scale bar = 50 μm)

References

1 W. H. Xu, L. Wang, J. Wang, G. P. Sheng, J. H. Liu, H. Q. Yu and X. J. Huang, *CrystEngComm*, 2013, **15**, 7895–7903.

2 S. R. Li, Y. Sun, S. Y. Ge, Y. Qiao, Y. M. Chen, I. Lieberwirth, Y. Yu and C. H. Chen, *Chem. Eng. J.*, 2012, **192**, 226–231.

3 R. Murugan and S. Ramakrishna, *Biomaterials*, 2004, **25**, 3829–3835.